

Answer Key:

$$\frac{B_p}{M} = \frac{3\rho z}{r^5} + \frac{15Q}{8} \frac{\rho z}{r^7} \frac{(4z^2 - 3\rho^2)}{r^2} + \frac{K}{a_1} \frac{\rho}{[(|z| + a_1)^2 + \rho^2]^{3/2}}, \quad (1)$$

$$\frac{B_z}{M} = \frac{2z^2 - \rho^2}{r^5} + \frac{3Q}{8} \frac{(8z^4 + 3\rho^4 - 24\rho^2 z^2)}{r^9} + \frac{K}{a_1} \frac{|z| + a_1}{[(|z| + a_1)^2 + \rho^2]^{3/2}}, \quad (2)$$

For $z = -3.48 \times 10^7$ kilometers $\rho = 1.46 \times 10^8$ kilometers.
 Then $r = 1.5 \times 10^8$ kilometers.....this equals the Earth-Sun orbital distance!

$$\frac{B_p/M}{M} = \frac{3(1.46 \times 10^8)(-3.48 \times 10^7)}{(1.5 \times 10^8)^5} + \frac{15(1.5)(1.46 \times 10^8)(-3.48 \times 10^7)}{8} \frac{(4(-3.48 \times 10^7)^2 - 3(1.46 \times 10^8)^2)}{(1.5 \times 10^8)^7} + \frac{1.0}{1.07 \times 10^{16}} \frac{1.46 \times 10^8}{[(3.48 \times 10^7 + 1.07 \times 10^{16})^2 + (1.46 \times 10^8)^2]^{3/2}}$$

$$B_p = (6.03 \times 10^{17})(-2.0 \times 10^{-25} + 2.3 \times 10^{-41} + 4.0 \times 10^{-23}) = 2.4 \times 10^{-5} \text{ Gauss}$$

$$\frac{B_z/M}{M} = \frac{2(-3.48 \times 10^7)^2 - (1.46 \times 10^8)^2}{(1.5 \times 10^8)^5} + \frac{3(1.5)[8(-3.48 \times 10^7)^4 + 3(1.5 \times 10^8)^4 - 24(1.46 \times 10^8)^2(-3.48 \times 10^7)^2]}{8} \frac{(3.48 \times 10^7 + 1.07 \times 10^6)}{(1.07 \times 10^{16})([(3.48 \times 10^7 + 1.07 \times 10^6)^2 + (1.46 \times 10^8)^2]^{3/2})}$$

$$B_z = (6.03 \times 10^{17})(-2.5 \times 10^{-25} + 1.1 \times 10^{-41} + 9.8 \times 10^{-24}) = 5.8 \times 10^{-6} \text{ Gauss}$$

Problem 2: Use the Pythagorean Theorem to find B. $B = 2.5 \times 10^{-5}$ Gauss.

Problem 3: If you plot the value of B on the z-r plane, it will be symmetric along the z axis, reflected through a line at z=0. This is demonstrated in the figure on the front page of this problem.